YES! Expo – Inspiring Youth to Pursue Education and Careers in Science and Engineering

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Introduction

Our nation faces a serious crisis of youth losing interest in Science, Technology, Engineering, and Math (STEM). Michigan and other technology and manufacturing centers have already suffered significantly from this decline. Additionally, women and minorities are vastly under-represented in STEM fields. Until these trends are reversed, the nation will struggle to develop a highly skilled and knowledgeable workforce for the 21st century who will sustain the nation's position as a global leader in science and engineering. The Youth Engineering and Science (YES!) Expo was designed by Michigan Technological University to address this problem. The YES! Expo aims to generate interest and enthusiasm in engineering, science and technology among Michigan's youth, and to encourage these youth to attend engineering and science programs at institutions of higher education and ultimately pursue employment with Michigan corporations.

The Problem

The YES! Expo takes place at a critical time in attracting Michigan youth to science and engineering education. In recent years students have been losing interest in post-secondary education in STEM fields. Between 1975 and 1999, the U.S. slipped from third to fourteenth place in the proportion of twenty-four-year-olds holding science and engineering degrees. Furthermore, between 1985 and 2000, the number of baccalaureate degrees in science, technology, engineering, and math fell by 18.6 percent (Goodchild, 2004). There is also a downward trend in the percentage of college-bound students who take the ACT and indicate planned majors in engineering and science (ACT National and State Scores, 2006) (Figure 1).

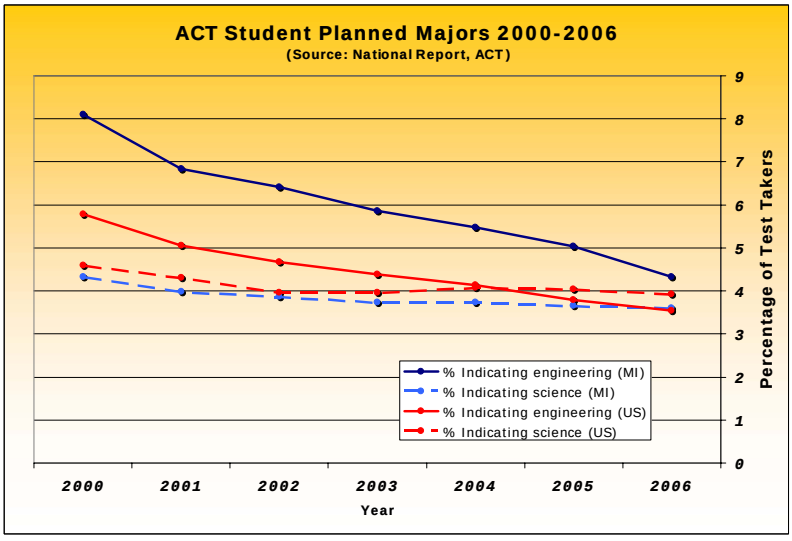

Figure 1. Students planning to enroll in science and engineering majors.

Although there is no clear consensus on why students are losing interest in STEM education, some ideas include lack of preparation in middle and high school and the rigors of college majors in these fields. In teacher focus groups conducted at the YES! Expo 2006 a major theme emerged that students are looking for relevance and an opportunity to explore how STEM classes will prepare them for their careers. Yet teachers reported that course work is disconnected from the application of that knowledge as applied in the workplace.

Without a skilled technical workforce and the innovations and new products they create, our nation's economy will be in jeopardy, leading to a lower standard of living. The scientific and technical foundations of our nation are eroding at a time when many other countries report growth in these areas. The low-wage culture in many of these countries adds to the problem by creating a competitive advantage over the United States. As a nation we must urgently realize that in order to maintain our position as a global scientific and technical leader, we must increase interest in STEM education and careers (National Academy of Sciences, 2005).

Ethnic diversity in engineering continues to be low even though the overall number of minorities in the general workforce is increasing. White males make up nearly two-thirds of all U.S. undergraduate and graduate engineering students, while minorities earn only about 12 percent of the engineering degrees awarded in the U.S. (ASEE Report, 2006). Despite this bleak picture, increasing workplace diversity is critical in order for engineers to find solutions to societal problems as the minority population in the U.S. increases.

Females are also underrepresented in university engineering programs (20 percent) and in the high-tech workplace (10 percent) (Remick and Cook, 2007). So why aren't females entering, and remaining in, the science and technology workforce? Several possible answers may include family considerations and workplace locations that are not attractive to women, especially single women.

The Solution

The YES! Expo tackles these issues head-on by promoting and encouraging students in grades eight through twelve, primarily attending Detroit and southeastern Michigan schools, to choose exciting and rewarding careers in engineering and science. The YES! Expo contributes to Michigan's higher educational system which supplies companies with productive, innovative engineers and scientists. The ability to fill engineering and science jobs contributes to the success of Michigan's economy and the many major manufacturing companies that choose to be headquartered here.

The YES! Expo was first held in 2004 at Crisler Arena at the University of Michigan in Ann Arbor, attracting 5,000 students. In 2005, the event was moved to Ford Field in Detroit in order to facilitate attendance by Detroit area schools. The large venue of Ford Field allowed the YES! Expo to grow sufficiently to host 13,000 students in 2005 and 15,000 students in 2006. We estimate that one teacher was present for every 10 students.

The YES! Expo consists of two elements: 1) a tradeshow-style format where corporations, universities and other organizations provide and staff exhibits intended to expose students to

exciting technology-based careers and educational programs; and 2) a live/multimedia educational program highlighting technology, education, and careers in a fun and entertaining way. The show lets students know there's lots of "cool" in technology and the people behind technology, and that not long ago those engineers and scientists were just like them. A Teacher Resource Center was also introduced in 2006 to provide teachers with activities related to engineering and science they could take back to their classrooms. Participating universities provided information about their professional development programs for teachers while several companies and organizations introduced teachers to curriculum based programs in engineering and the environment.

Sponsoring companies have the opportunity to secure exhibit space at the YES! Expo so students can become familiar with the technology/science careers that they offer. Corporate sponsorships and grants allow students to attend at no cost. On entering Ford Field, students experience a stadium full of exciting engineering and science exhibits from corporations and have the opportunity to talk with real engineers and scientists. Other display space is hosted by universities, professional societies, youth organizations, state organizations and business development organizations from throughout Michigan. Universities provide exhibits showing unique and dynamic educational pathways that lead to technology-based careers and demonstrate to students what they will be doing in college as they study engineering and science. Special exhibits such as the New Detroit Science Center, NASA, and FIRST Robotics provide hands-on experiences and demonstrations that create excitement and wonder about the world of science and engineering.

The cornerstone of theYES! Expo is a high-energy, professionally produced educational show. This live/multimedia theatre-in-the-round program, held on the playing field, strives to make engineering and science relevant and appealing to students by highlighting the people behind the technologies that students appreciate. It demonstrates that these people were once just like them, and that Michigan youth too can be part of the technologies that create the future. It has historically been our goal to secure a keynote speaker or performer with a proven track record of relating science to youth; in the past, guests have included Paul Zaloom, star of HBO's Beakman's World; National Public Radio personality Bill Hammack, known as the Engineering Guy; retired NASA astronaut Dr. Jerry Linenger; and Bill Nye, the Science Guy.

The YES! Expo is a unique collaboration of more than 60 companies, 25 universities/colleges, the State of Michigan, professional societies, youth organizations, and community organizations. To our knowledge, an event involving so many corporations and universities - all directed at addressing serious future shortfalls in the state's high-tech job base - has never been presented before.

Diversity

Special emphasis is placed on recruiting minority students to attend the YES! Expo. Locating YES! Expo in downtown Detroit provides a unique setting that allows us to reach a large population of disadvantaged and underrepresented students. We have worked closely with groups consisting largely of minority populations such as the Detroit Public Schools, the Detroit Federation of Teachers, and the Detroit Area Pre-College Engineering Program (DAPCEP) to

encourage teachers to register and bring their students to the YES! Expo. In the two years that YES! Expo has been held in downtown Detroit, the average yearly attendance is 220 schools. The percentage of ethnic groups can be estimated by studying the demographic data of these schools (Table 1) (SchoolMatters, 2007).

Table 1. Estimated ethnic diversity (Percent of total attendance)	
African American	50.7
Caucasian	42.2
Hispanic	3.9
Asian & Pacific Islander	1.7
Multicultural	1.1
Native American	0.4

Encouraged by the percentage of African American students who attended, we have worked with the National Society of Black Engineers to continue their participation. However, we would like to increase attendance in other ethnic groups, and to that end are engaging professional organizations such as the Society of Hispanic Professional Engineers and the American Indian Science and Engineering Society.

The general classroom population is approximately 50 percent female. As expected, females also make up approximately half of the students attending theYES! Expo.

Impact and assessment of the YES! Expo

Over the past three years we have conducted post-event evaluations with the students, teachers and exhibitors attending theYES! Expo. These surveys are then evaluated by the YES! Expo Leadership Team, and appropriate action is taken to resolve problems and strengthen the program. In 2006, Dow Corning Corporation funded the addition of pre/post-event student surveys to better determine the influence of the event. A representative group of teachers in the Detroit area was asked to survey their students before and after attending the YES! Expo 2006. A total of 344 students participated in the survey. Pre-event surveys were taken 1-2 days prior to the event, with the post-event surveys occurring approximately 1 week afterward. Data analysis was based on 224 students (65 %) who returned both the pre- and post-event surveys. The results demonstrate that the YES! Expo had a positive impact on how students viewed continuing their education past high school in engineering and science fields and ultimately pursuing technology-based careers. Highlights of the analysis showed:

- 83% of respondents said the YES! Expo made them think more about continuing their education after high school.
- 63% of respondents said they learned more about Michigan universities.
- 75% of respondents said they have a much better understanding of what engineers and scientists do.
- Student interest in majoring in engineering or science in college increased significantly ($P<.05$) from 34 to 40 percent.

- Student interest in enrolling in honors or advanced classes increased (P=.051) from 67 to 71 percent.
- 67% of respondents said the YES! Expo led to better understanding of their personal career goals.

Furthermore, the survey results provided us with a new understanding that knowing an engineer is a strong contributing factor in students considering engineering as a career. The YES! Expo provides a setting where students can meet and talk with real engineers and scientists, and we believe that this interaction has a significant positive influence. Meeting people in technology-based careers enables students to see the connection between what is taught in the classroom and how it is applied in the workplace. Maintaining and enhancing this face-to-face interaction is essential to developing students' interest in considering post-secondary education in STEM fields.

Conclusion

Showing students the interrelationship between class work and related careers is a key factor in increasing student likelihood of pursing a technical education beyond high school. Students are looking for relevance and the opportunity to explore how a technical degree might prepare them to join the workforce and make a difference in society. Events like the YES! Expo provide the setting for this interaction to take place. However, the YES! Expo is just one player in this process. There are many examples of companies which work with their local schools by bringing classes into their facilities, showing them the exciting work they do, and talking passionately about their careers and education. Educational organizations provide teachers with relevance-based classroom activities that demonstrate how engineering and science principles can be used to improve our society. Pre-college programs like FIRST Robotics, DAPCEP, MATHCOUNTS, and university summer programs, also provide hands-on, discovery-based learning that further develops student knowledge and interest in STEM fields. These types of programs emphasizing the connection between classroom and workplace will enable us to motivate students to choose education and careers in engineering and science. Our future as a global leader in technology and science depends on it.

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Biographical Information

PETER J. CATTELINO earned a BS degree from Michigan Technological University and is the Director of the YES! Expo. He is responsible for all aspects of the event including sponsor and school/student recruitment, budgeting, logistics, and communications and promotion.

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JOHN R. LEHMAN is the Associate Vice-President of Enrollment Services at Michigan Technological University. John provides vision and administrative support in executing the YES! Expo and developing the YES! Expo Teacher Resource Center.

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